REMARKS/ARGUMENTS

Claims 1, 3, 5, 6, 8 to 19, 21 and 22 are pending in this application. With this amendment, claims 1 and 13 have been amended, and claims 2, 4, 7 and 20 have been cancelled. No new subject matter has been introduced with these amendments.

Double Patenting Rejection

The Examiner rejects all of the pending claims under the judicially created doctrine of nonstatutory double patenting. Although Applicants disagree with the substance of the rejection, to speed prosecution Applicants will file a terminal disclaimer in compliance with 37 CFR 1.321(c) to overcome this rejection once allowable subject matter has been indicated.

Rejections Under 35 U.S.C. §103(a)

A. Claims 1 to 12

The Examiner also rejected all of the pending claims under 35 U.S.C. §103(a) as being unpatentable over any of Cackett, et al. or Japanese Patent No. 2002-45960. Applicants respectfully traverse these rejections as well.

First with reference to independent claim 1, and claims 3 to 12, which depend therefrom, these claims have been newly amended to require that the investment casting mold be held at a temperature around the glass transition of the amorphous alloy. This amendment is supported in the specification at page 10 lines 19 to 35, which states in relevant part that:

> Even though, heating the investment shell can aid the release of trapped gas and humidity just before the introduction of molten metal, the heating of the investment shell should be limited to temperatures around the glass transition temperature rather than close to the melting temperature of these alloys. This become particularly important for the case of Zr-Ti based alloys, which may react with the investment shell and degrade the surface quality of the casting.

All of the prior art references, where they discuss the investment casting process at all, including the Japanese publication, discuss heating the mold to a high temperature somewhere near the melting temperature of the alloy. For Example, the Cackett et al. reference does not actually teach any relevant methodology for investment casting of amorphous alloys. Rather, in one disjointed section, the authors provide a laundry list of possible forming techniques, including forging, investment casting and casting, machining, super-plastic forming, etc.; and in the same section provide another laundry list of possible materials including titanium and alloys, stainless steel, amorphous metals, vitreous metals, etc. (See, e.g., Cackett et al. col. 10, line 60 to col. 12, line 19.) Nowhere in this section do Cackett et al. ever teach or even suggest that one could investment cast an amorphous alloy, much less provide an actual set of processing steps for doing such. Moreover, Cackett et al. actual state that "the metal for forging or casting is preferably titanium or titanium alloy . . . ." (Cackett et al., col. 10, line 67 to col. 11, line 3.) Accordingly, Applicants do not believe that one of ordinary skill in the art would have been motivated to use investment casting, a technique with processing conditions that are seemingly contrary to the entire notion of a fast cooling material, and applied it to amorphous alloys, a material notorious for its fast cooling requirements.

Likewise, although the Japanese reference actually does mention a quenching step, the Japanese reference requires that the investment mold be cooled to a temperature below the "crystallization temperature" of the amorphous material during the introduction of the material. For example, the Japanese patent states:

> [0010] That is, invention of this application claim 1 publication is the casting approach of the amorphous alloy characterized by cooling said mold below to the crystallization temperature of said amorphous alloy, and casting a dissolution metal in the casting approach which casts the dissolution metal of the presentation which has amorphous organization potency to the mold manufactured by the lost wax process, and makes it an amorphous alloy.

(Japanese Patent No. 2002-045960A, Paragraph 0010, emphasis added.)

Accordingly, one of ordinary skill in the art, having read the Cackett and Japanese patents would have thought it necessary to quench the investment casting mold prior to introducing the material into the mold to below the crystallization temperature. This is in direct contradiction to the teaching of the current invention.

In light of these contradictory disclosures, Applicants submit that one of ordinary skill in the art having read the Japanese Patent would have had no motivation to develop the claimed investment casting process requiring that the investment mold be heated to a temperature "around the glass transition temperature" of the amorphous alloy, and would have indeed been directed away from such a method. As such, Applicants also respectfully request reconsideration and withdrawal of this rejection.

B. Claims 13 to 16

Finally, although the Examiner tacitly acknowledges that the prior art does not disclose or even suggest selecting a bulk solidifying amorphous alloy based on the "crystallization stability", as required by claims 13 to 16, he states that it "would have been obvious to choose optimal process parameters depending on the particular amorphous alloy system to be cast through routine experimentation." This seems to discount the fact that Applicants are not choosing an operating parameter based on an alloy system, but are rather specifying as part of the process those amorphous alloys that may be used. Applicants would again point out that investment casting had been previously considered incompatible with amorphous alloys. Among other contributions, Applicants have discovered a way of determining which alloys may be processed using the inventive investment casting regime.

Even if the Examiner maintains his position that it would have been routine to set some of the specific parameters, such as mold thickness, etc., nowhere is there any teaching or even suggestion that would lead one of ordinary skill in the art to select amorphous alloys based on the parameters set forth in this application. Indeed, the cited prior art disclosures never discuss these parameters even in the abstract, much less the importance of these parameters in determining whether a particular alloy could

be employed in an investment casting regime. Indeed, most of the prior art limit their discussion of amorphous alloys to a single line of text, which provides no guidance whatsoever on what materials might be selected.

For example, in the Japanese publication, only two types of amorphous alloys are specified, and those are selected only in terms of the "cooling rate" of the alloy in question, not in the special terms of the "crystallization stability of the alloy" as proposed in the current application. (See, e.g., Translated Japanese Publication, page 6, paragraph 0018.)

To explain the significant difference between "cooling rate" and "crystallization stability" Applicants would like to point to the Specification, which defines these two very different parameters as follows. The critical cooling rate is merely the cooling rate required to "retain their amorphous atomic structures." (Specification, page 6, lines 5 to 17.) In contrast, the "crystallization stability" is a measurement that takes into account the temperature ranges (ΔT_N) over which the material crystallizes and the enthalpy of crystallizations (ΔH_N) for each of those temperature ranges. In turn, the specification recites that a preferred composition is one where the ratio of $\Delta H_N/\Delta T_N$ for the first crystallization step higher than the other crystallization steps. This parameter is never discussed in any of the prior art, nor is it at all comparable to merely examining the critical cooling rate of the alloy material as the cited prior art appears to do.

Meanwhile, Cackett et al., merely states baldly that "amorphous alloys" may be "cast". (Cackett, et al. col. 8, lines 9-11.) This statement doesn't even specify whether or not the amorphous alloy is bulk-solidifying or not.

Likewise, the Peker et al. patents do not specify the specific material parameters used for selecting a candidate for investment casting. Nor is this surprising, as none of the cited Peker et al. patents are directed to the current investment casting process. Applicants would suggest that though these patents do seek to cover other shaping processes for amorphous alloys, including various forms of molding and casting, nowhere have the current Applicants ever described, disclosed, or even suggested that amorphous alloys could be used in an investment casting process, as claimed in the

current application. Moreover, Applicants repeatedly stress in both the Background and Detailed Description of the current application why investment casting of amorphous alloys presents specific challenges that are not present, and thus would not have been addressed, in developing other types of amorphous alloy molding and casting techniques.

Because of the above differences and deficiencies in the cited prior art, Applicants respectfully suggest that claims 13 to 18 are patentable over the cited prior art references.

Conclusion

In view of the foregoing amendment and response, it is believed that the application is in condition for allowance and, accordingly, reconsideration and allowance is earnestly solicited.

If any questions remain regarding the allowability of the application, Applicant would appreciate if the Examiner would advise the undersigned by telephone.

The Commissioner is hereby authorized to charge any fees under 37 CFR 1.16 and 1.17 which may be required by this paper to Deposit Account No. 03-1728. Please show our docket number with any charge or credit to our Deposit Account.

Respectfully submitted,

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